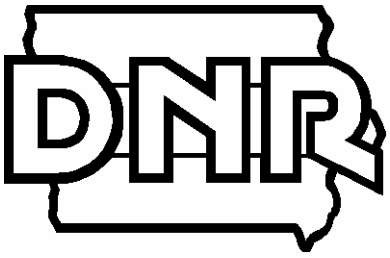
Total Maximum Daily Load
For Priority Organics
Yeader Creek
Polk County, Iowa

2005

Iowa Department of Natural Resources
TMDL & Water Quality Assessment Section



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1. Executive Summary

Table 1. Yeader Creek Summary

Waterbody Name:	Yeader Creek
County:	Polk
Use Designation Class:	General Use
Major River Basin:	Lower Des Moines River Basin
Pollutants:	Ethylene and propylene glycol
Pollutant Sources:	Des Moines International Airport (DMIA)
Impaired Use(s):	General Use
2002 303d Priority:	Medium
Watershed Area:	3,630 acres
Segment Length:	3.5 miles
Load Allocation:	Zero (there are no nonpoint sources)
Ethylene Glycol Limits for DMIA:	125.0 mg/l (30-day average) 190.0 mg/l (daily maximum)
Propylene Glycol Limits for DMIA:	100.0 mg/l (30-day average) 150.0 mg/l (daily maximum)
Biological Target:	Benthic Macroinvertebrate Index of Biotic Integrity (BMIBI) = 43

The Federal Clean Water Act requires the Iowa Department of Natural Resources (IDNR) develop a pollutant total maximum daily load (TMDL) for waterbodies on the state's impaired (303d) waters list. Yeader Creek has been assessed as impaired by priority organics, specifically propylene and ethylene glycol. The purpose of this TMDL is to estimate the maximum glycol loading that can be delivered to the stream while meeting water quality standards. Propylene glycol and ethylene glycol are chemicals used in the deicing of aircraft at the Des Moines International Airport (DMIA). Airport drainage forms the headwaters of Yeader Creek and is associated with the Yeader Creek impairment.

The airport is required to have a National Pollutant Discharge Elimination System (NPDES) stormwater discharge permit. The airport's first stormwater permit was issued May 10, 1999 and the current permit was issued by IDNR on August 30, 2004. The permit includes water quality limits that are not included as a part of this TMDL for priority organics. The current permit includes concentration limits for propylene and ethylene glycol, carbonaceous biological oxygen demand (CBOD), minimum dissolved oxygen concentration, and prohibits the use of Type II deicers. It also requires monitoring of Yeader Creek for glycol compounds, CBOD, and dissolved oxygen near the airport's stormwater outfall and at three other downstream locations.

The glycol TMDL for Yeader Creek consists of two phases. Phase 1 will use the pollutant concentration limits established by the airport's recent NPDES stormwater permit as the TMDL target. The TMDL also includes a biological target to provide a margin of safety to account for assessment uncertainty. The monitoring required by the permit will be used to determine whether or not the discharge from the airport complies with water quality standards. Phase 2 will consist of a review of the monitoring records, a stream bioassessment to evaluate attainment of the aquatic life general use target, and a determination of water quality standards compliance. If it is determined that the

stream water quality does not support uses due to glycol then the wasteload allocations will be reviewed and readjusted.

This TMDL has been prepared in compliance with the current regulations for TMDL development that were promulgated in 1992 as 40 CFR Part 130.7. These regulations and consequent TMDL development are summarized below:

1. **Name and geographic location of the impaired or threatened waterbody for which the TMDL is being established:** Yeader Creek, S27, T78N, R24W, on the south side of Des Moines, Polk County.

2. **Identification of the pollutant and applicable water quality standards:** The pollutants causing the water quality impairments are priority organics, specifically deicing chemicals containing glycol compounds. Yeader Creek is classified a general use stream. Excess priority organic chemical loading has violated water quality standards narrative criteria (567 IAC 61.3(2)c and 61.3(2)d) and impaired the general use of the waterbody.

3. **Quantification of the pollutant load that may be present in the waterbody and still allow attainment and maintenance of water quality standards:** The Phase 1 glycol targets for this TMDL are the permit limits found in the DMIA NPDES stormwater permit. An additional target requires bioassessments that demonstrate attainment of aquatic life general use.

4. **Quantification of the amount or degree by which the current pollutant load in the waterbody, including the pollutant from upstream sources that is being accounted for as background loading, deviates from the pollutant load needed to attain and maintain water quality standards:** The existing average concentrations of ethylene and propylene glycol are 14.7 mg/l and 19.7 mg/l, respectively. The maximum concentrations of ethylene and propylene glycol measured in the past three winters are 49.0 mg/l and 76.4 mg/l, respectively.

5. **Identification of pollution source categories:** The source of glycol compounds that have impaired Yeader Creek is stormwater from the DMIA.

6. **Wasteload allocations for pollutants from point sources:** The only significant source of ethylene and propylene glycol in the Yeader Creek watershed is the DMIA. These chemicals are associated with aircraft deicing activities. An NPDES stormwater permit limits discharges of glycol from the airport. The TMDL wasteload allocation for Yeader Creek consists of the concentrations in the current NPDES permit as shown in Table 2.

Table 2. TMDL Wasteload allocation for the Des Moines International Airport.

	30-day Average concentration (mg/l)	Daily Maximum concentration (mg/l)
Ethylene Glycol	125.0 mg/l	190.0 mg/l
Propylene Glycol	100.0 mg/l	150.0 mg/l

This TMDL also acknowledges that the NPDES stormwater permit contains additional requirements to protect waterbody general use. The permit limits dissolved oxygen, biological oxygen demand, ammonia, oil and grease, and pH. The permit prohibits the use and discharge of glycol-based Type II deicing and anti-icing compounds and requires that the maximum possible amount of glycol-contaminated stormwater be sent to the Des Moines Wastewater Reclamation Facility for treatment.

7. **Load allocations for pollutants from nonpoint sources:** There are no known significant nonpoint sources of glycol in the watershed; therefore, the glycol load allocation for nonpoint sources in the Yeader Creek watershed is zero.

8. **A margin of safety:** The margin of safety for this TMDL is implicit, based on the use of a biological target in addition to the wasteload allocations for glycol in the DMIA NPDES permit. In the event that the biological target is not achieved despite documented evidence that glycol discharge limits have been met, IDNR will conduct additional monitoring and stressor analysis to determine the cause(s) of biological impairment.

9. **Consideration of seasonal variation:** This TMDL was developed based on the annual glycol loading that will result in attainment of targets for the deicing season (October through May) and biological targets throughout the year.

10. **Allowance for reasonably foreseeable increases in pollutant loads:** An allowance for increased glycol loading was not included in this TMDL. The airport will be required to provide additional collection and treatment of polluted stormwater that would cause increases in glycol loading to Yeader Creek through enforcement of the NPDES stormwater permit.

11. **Implementation plan:** Although not required by the current regulations, an implementation plan is outlined in the body of the report.

2. Yeader Creek, Description and History

2.1 The Creek

Yeader Creek is located in the City of Des Moines just east of the Des Moines International Airport (DMIA). Drainage from a part of the airport forms the headwaters of Yeader Creek. The 3.5-mile creek then flows eastward through the city's south side into Ewing Park and discharges into Easter Lake.

Table 3. Yeader Creek Characteristics

Waterbody Name:	Yeader Creek
Hydrologic Unit Code:	HUC10 0710000815
IDNR Waterbody ID:	IA 04-LDM-0340_0
Location:	Section 27 T78N R24W
Latitude:	41° 33' N
Longitude:	93° 35' W
Water Quality Standards Designated Uses:	General Use
Tributaries:	Little White Breast Creek
Receiving Waterbody:	Easter Lake
Segment Length:	3.5 miles
Watershed Area:	3,630 acres

Hydrology

The Yeader Creek watershed is primarily urban residential and commercial. Because of this the time of concentration is short and the stream is "flashy", i.e. subject to rapid increase and decrease in flow in response to precipitation. The instantaneous flow has been measured at Site 1 (see Figure B-1 of Appendix B for site locations) 475 times between October 1999 and April 2004 providing a good range of flow conditions for evaluation. The highest measured flow in that period was 52 cfs and there were three instances of no flow. Therefore, dry weather base flow is at or below 0.1 cfs (45 gpm).

Table 4. Ranges of flow in Yeader Creek. Measurements were taken between October 1999 and April 2004.

Measured flow	Number of measurements	Percentage of total number of measurements
1.0 to 52 cfs	32	7%
1.0 to 0.50 cfs	21	5%
0.50 to 0.10 cfs	131	28%
0.10 to 0.01 cfs	278	60%

Event samplers with continuous stage measurement were installed in Yeader Creek starting mid-June 2004 and continuing through early November. This data will be used in the TMDL for Easter Lake, but is not included here because the samples do not include monitoring from the deicing season.

2.2 The Watershed

The Yeader Creek watershed has an area of 3,630 acres. One tributary, Little White Breast Creek, flows into Yeader Creek. The confluence of the streams is 150 feet

upstream of Easter Lake. The landuses and associated areas for this predominantly urban watershed are shown in Table 5.

Table 5. 2002 Yeader Creek Landuse

Landuse	Area in Acres	Percent of Total Area
Urban - Residential	2510	69
Urban - Commercial	320	9
Des Moines International Airport	310	9
Ewing Park	220	6
Other (roads, parks, etc.)	270	7
Total	3,630	100

The watershed is predominately gently to strongly sloping (2-14%) prairie-derived soils developed from loess and till. There are three soil types in the watershed: Sharpsburg, Shelby, and Adair. Average rainfall in the area is 30.8 inches/year.

3. TMDL for Priority Organics

3.1 Problem Identification

Impaired Beneficial Uses and Applicable Water Quality Standards

Yeader Creek is classified as a general use stream in the *Iowa Water Quality Standards* (1). It was placed on the impaired waters list in 1998 based on analysis by the IDNR of severe impacts caused by deicing materials discharged from the airport to the creek. In 1997, after receiving many complaints about the water quality conditions in Yeader Creek, DNR staff investigated and collected water samples. A report from the inspection at a site immediately downstream of the airport discharge made the following observations:

- the stream flow was estimated to be 2 to 3 cfs;
- the water had a greenish color and smelled like wastewater;
- there were not any fish present based on electro-fishing results,
- there were not any benthic macroinvertabrates present,
- exposed substrate was an unusual rust color (orange),
- embedded substrate was an unusual black, suggesting anaerobic conditions,

At two downstream locations it was reported that:

- water in pools had the same non-algal green color as at the airport location,
- the water had the “same odor of sewage and sweetener”.

The April 1997 samples collected near the airport outfall showed:

- ethylene glycol concentrations of 65 to 120 mg/l,
- propylene glycol concentrations of 210 to 490 mg/l, and
- 5 day biochemical oxygen demand concentrations of from 350 to 1,200 mg/l

The conclusion of the investigation was that the Yeader Creek reach immediately downstream from the airport outfall was “severely polluted” and violated Section 61.3(2) of the *Iowa Water Quality Standards* for general water quality as follows:

61.3(2)c: *Such waters shall be free from materials attributable to wastewater discharges or agricultural practices producing objectionable color, odor, or other aesthetically objectionable conditions.* Compared to conditions observed during previous surveys of small Iowa streams the greenish color and sewage-like odor observed in Yeader Creek are violations of this standard.

61.3(2)d: *Such waters shall be free from substances attributable to wastewater discharges or agricultural practices in concentrations or combinations which are acutely toxic to human, animal or plant life.* The lack of typical forms of aquatic life associated with small streams such as Yeader Creek suggests water quality acutely toxic to animal aquatic life.

The general use for Yeader Creek has been assessed as "not supporting" for the 2000 and 2002 water quality assessment cycles based on the 1997 IDNR investigation. DMIA began monitoring Yeader Creek in October 1999 for glycol, BOD, and dissolved oxygen and started the collection, storage, and treatment of deicing contaminated runoff in 2002.

Background

Ethylene glycol and propylene glycol are chemicals found in the deicing/anti-icing agents used at airports as well as in automobile antifreeze. Deicing fluids are primarily composed of water and either propylene glycol or ethylene glycol. Propylene glycol based fluids have a higher biological oxygen demand than ethylene glycol based fluids. All deicing agents contain additional, unnamed compounds that contribute to their toxicity to aquatic life. (2,3)

There are four types of airplane deicing fluids available. They are distinguished by the form of glycol used and by the time frame of their use. All deicing/anti-icing fluids may be made of either ethylene or propylene glycol. Type I fluids are used when the departing plane will have a 5-minute to 15-minute holdover time before takeoff. These are generally considered less toxic than the other deicing fluids. Type II and Type IV fluids are more viscous, so they are able to stay on the aircraft longer. They can be used when the departing plane will have up to 30-minute (Type II) or 80-minute (Type IV) holdover times before takeoff. (3)

Under stormwater regulations promulgated in the early 1990s, airports have been required to obtain NPDES stormwater permits. The Des Moines airport operated under a general permit until it became apparent that an individual permit was needed to protect water quality.

In October of 1997, the DMIA began using vacuum recovery of deicing agents. This was discontinued as an inadequate solution in December 1999. In 1999, an individual stormwater NPDES permit was issued to the Des Moines airport. The permit included specific numeric limits for ethylene glycol and biochemical oxygen demand to Yeader Creek and required monitoring of the creek during the deicing season.

In response to the requirements of the stormwater permit, the airport constructed facilities to collect and transport runoff from its deicing operations to large holding tanks. The discharge from these tanks is sent to the regional wastewater treatment plant in Des Moines through the sanitary sewer system. Only during the peak precipitation events do

these tanks overflow and discharge to Yeader Creek. Snow dump areas were designated to confine snowmelt to the detention system. Between December 1999 and March 2003, 65 million gallons of stormwater was collected and sent to the wastewater treatment plant.

Prior to the construction and operation of runoff controls, IDNR sent the following notices of violation to DMIA:

- April 25, 2000, exceeds permit BOD limits, discharge discolors stream;
- January 18, 2001, discharges causing yellowish stream coloring;
- February 19, 2001, exceeded BOD limit several more times in 2000;
- April 12, 2001,exceeded BOD limits in February, 2001;
- May 10, 2001, orange water with a floating scum in stream

Coloration issues were also noted on November 13, 2001, but no violation was issued.

Since the end of the 2001 deicing season there has been one IDNR notice of violation to DMIA on April 3, 2003 for exceeding the BOD permits limits in January 2003.

On August 30, 2004 the airport's individual stormwater permit was renewed (4). The changes in the permit limits are shown in Table 6. In addition to the earlier limits on ethylene glycol, the new permit includes limits on propylene glycol limits and additional glycol monitoring at three sites downstream of the airport stormwater discharge. Appendix B includes a map of the four monitoring sites. The additional monitoring will begin in the 2004/2005 deicing season and the data will be used to assess downstream impacts of glycol. The current stormwater permit may be found in Appendix D.

In 2003, DMIA was nominated for an Environmental Achievement Award from the Airports Council International – North America. IDNR supported the award, stating, "DMIA has invested considerable effort in structural and operational changes to reduce stormwater pollutant runoff associated with aircraft deicing/anti-icing activities, to Yeader Creek."

Table 6. Summary of NPDES permit limits and limit changes for the DMIA (4).

Permit Date	5/4/1999		8/30/2004	
	Average	Maximum	Average	Maximum
$CBOD_5$	100.0 mg/l	150.0 mg/l	100.0 mg/l	150.0 mg/l
NH_3-N	4.0 mg/l	8.7 mg/l	4.0 mg/l	8.7 mg/l
Oil and Grease	10.0 mg/l	15.0 mg/l	10.0 mg/l	15.0 mg/l
Ethylene Glycol	125.0 mg/l	190.0 mg/l	125.0 mg/l	190.0 mg/l
Propylene Glycol	No limit	No limit	100.0 mg/l	150.0 mg/l
pH	6.0 to 9.0		6.0 to 9.0	
Dissolved Oxygen	≥ 5.0 mg/l (October to May)		≥ 5.0 mg/l (October to May)	
Use of Type II Deicers	Permitted		Prohibited	

Data Sources

The Yeader Creek monitoring plan was developed by the engineering consultants at Camp Dresser McKee on behalf of the airport and was implemented in October 1999 (5,6). It included twice a week sampling for ethylene glycol, propylene glycol, COD, $CBOD_5$, ammonia, dissolved oxygen, temperature, and pH at monitoring Site 1 near the airports stormwater outfall and once a week sampling at three downstream monitoring locations for dissolved oxygen, temperature, conductivity, and pH. The data are summarized in Appendix A and a map of the monitoring sites is available in Appendix B.

The IDNR TMDL program performed targeted monitoring of Yeader Creek in 2004. This monitoring included sampling at two locations using auto-samplers to collect continuous stage data and samples during storm events that caused an increase is stream water elevation. Grab samples were collected and instantaneous flow was measured at these two sites twice per month. This data will be used in the Phase 2 evaluation and for the development of the TMDL for Easter Lake. However, because this data does not include samples from the deicing season, it is not included in this TMDL.

Biological monitoring data from IOWATER volunteers with level 2 biological training is available for October 2001, September 2002, May 2003, and October 2003. (Four samplings of level 1 data from the same volunteers from May 2000 to May 2001 are also available.) The data appear to show a trend towards water quality improvement in Yeader Creek (Table A-3 of Appendix A).

Interpreting Yeader Creek Water Quality Data

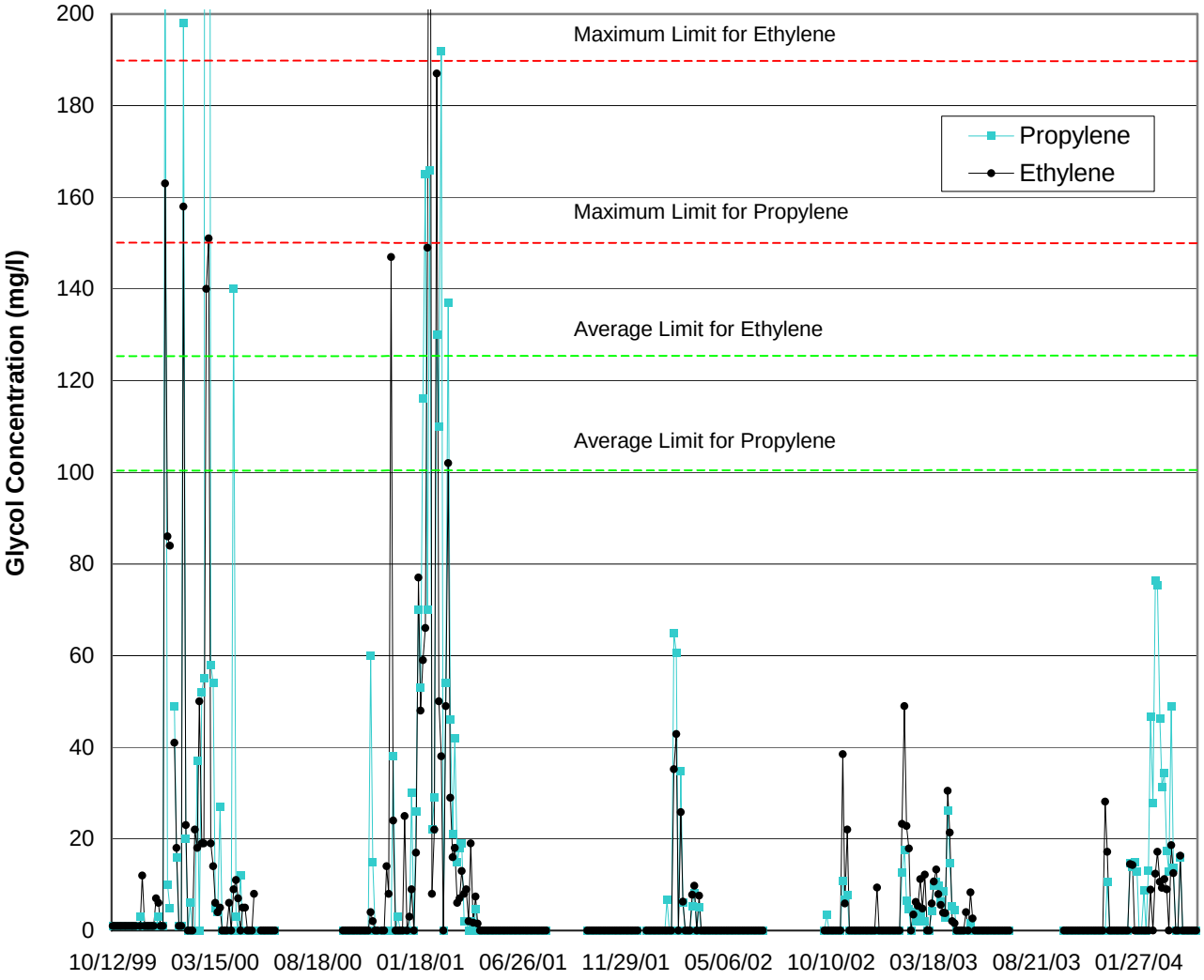
Data collected by the DMIA at the stormwater outfall to Yeader Creek shows a decline in the winter levels of ethylene and propylene glycol over levels seen in previous years. Table 7 shows the highest single sample for ethylene and propylene glycol during each winter and the highest monthly average for each winter.

The data show that the releases of glycol compounds from the DMIA have declined dramatically since the winter of 2000-01 (Figure 1). Also, landowners adjacent to Yeader Creek have commented on the recent improvement to the aesthetic appearance of the creek. There appears to be a trend towards water quality improvement.

Table 7. Maximum glycol levels in Yeader Creek at the outfall of the airport stormwater discharge. Samples are the highest daily or monthly average values for each winter.

Winter of Sampling	Propylene Glycol (mg/l)		Ethylene Glycol (mg/l)	
	Daily Max	Max Monthly Avg.	Daily Max	Max Monthly Avg.
1999-00	636.0	130.4	163.0	51.1
2000-01	192.0	84.3	328.0	75.6
2001-02	64.9	20.8	42.9	13.8
2002-03	26.1	6.9	49.0	9.0
2003-04	76.4	36.8	28.1	8.5

Figure 1. Ethylene and propylene glycol levels at the airport stormwater outfall to Yeader Creek from 1999 to 2004.



Potential Pollution Sources

The only source of the glycol priority organic pollutant to Yeader Creek is the stormwater discharge from the Des Moines International Airport. This discharge is covered by the airport's NPDES stormwater permit (4).

Natural Background Conditions

Natural background levels of propylene glycol and ethylene glycol are negligible.

3.2 TMDL Targets

There are two different Phase 1 targets for this TMDL. The first is a glycol target based on the numeric concentration limits in the DMIA NPDES permit issued by IDNR on August 30, 2004 and expiring August 29, 2009. The second target is a satisfactory index of biotic integrity score based on aquatic life assessments.

Criteria for Assessing Water Quality Standards Attainment

The State of Iowa does not have numeric water quality criteria for glycol compounds. The impairment is aesthetically objectionable conditions and acutely toxic conditions caused by excessive loading of ethylene and propylene glycol to the stream. The impairment is addressed by glycol concentration limits and a biological assessment target.

For the glycol targets, the pollutant loads associated with stormwater permit concentrations vary directly with the effluent and stream flow at the monitoring location. This location is described in the permit and is shown on the monitoring site map in Appendix B as Site 1. The existing DMIA NPDES stormwater permit limits for glycol and other parameters in Yeader Creek are as shown in Table 6.

Deicing fluids have high toxicity and biochemical oxygen demand that can create conditions that impair aquatic life use. For this reason, a biological target for Yeader Creek will also be used. The criterion used for assessing biological impairment of Yeader Creek is a Benthic Macroinvertebrate Index of Biotic Integrity (BMIBI) score of 43.

Biological restoration goals for streams that are designated for aquatic life uses (i.e., Class B), are typically set equal to the 25th percentile level of biotic index scores sampled from stream ecoregion reference sites (7). However, BMIBI and FIBI scores in Yeader Creek are expected to be lower than the ecoregion criteria for several reasons:

- Yeader Creek is classified as a general use stream in the water quality standards and is not specifically designated to be protected for aquatic life (Class B).
- The upper 1.5 miles of Yeader Creek is an intermittent stream that can support only a limited aquatic community.
- The drainage area of the entire stream is 3630 acres (5.7 square miles), the smallest size at which the biotic indices can be reliably used.
- While invertebrates may repopulate relatively quickly through aerial means, repopulation of stream-dwelling fish will be limited due to the barrier presented by Easter Lake.
- The high proportion of impervious surfaces (roads, parking lots, rooftops) in the watershed is uncharacteristic of the ecoregion and alters the stream flow conditions and the available habitat.

In lieu of the reference criterion, an alternative approach to setting the biotic condition goal for Yeader Creek will be used. The biological target for the BMIBI is set at 43, which corresponds to the median score within the “Fair” benthic macroinvertebrate rating category (Appendix C). This aquatic life goal represents a meaningful and attainable level of improvement from the severely degraded benthic macroinvertebrate assemblage

that was documented in 2004. The target score of 43 is equivalent to the 25th percentile of BMIBI scores measured at twenty stream sites located in the same landform region (i.e., Southern Iowa Drift Plain). These streams have similar geomorphology, water use designation (general use), and watershed size as Yeader Creek.

It is expected that fish populations can inhabit Yeader Creek; however, because of the irreversible habitat alterations caused by urban development and the impoundment of Yeader Creek at Easter Lake, the goal of supporting a balanced headwater fish assemblage is not feasible. Therefore, no FIBI target is established for this TMDL.

Selection of Environmental Conditions

The critical condition for the glycol portion of the TMDL is the cold-weather season (October-May). It is during this period that the deicing/anti-icing agents are used for aircraft safety. The critical condition for the biological targets is throughout the year.

3.3 Pollution Source Assessment

Existing Load

In the past five winters, the maximum concentrations of glycol at the stormwater outfall from the DMIA have been 636 mg/l for propylene glycol (March 2000) and 328 mg/l of ethylene glycol (February 2001). The average values during winter sampling (December to March) from December 1999 to March 2001 are 66 mg/l and 44.6 mg/l for propylene and ethylene glycol, respectively.

In the past three years, glycol levels have dropped significantly, with maximum concentrations at the stormwater outfall of 76.4 mg/l for propylene glycol (February 2004) and 49.0 mg/l of ethylene glycol (January 2003). The average values during winter sampling (December to March) from December 2001 to March 2004 are 19.7 mg/l and 14.7 mg/l for propylene and ethylene glycol, respectively.

Identification of Pollutant Sources

The only significant source of glycol in Yeader Creek is the DMIA stormwater discharge. The airport deicing operations are the source of the glycol in the Yeader Creek headwaters since there is little potential from other sources in the watershed.

Linkage of Sources to Target

The glycol found in Yeader Creek comes from deicing operations at the DMIA. Because deicing fluids have a significant toxicity and BOD associated with them, the potential impacts to aquatic life are also significant. Benthic macroinvertebrates have known sensitivities to toxic contaminants, including synthetic organic compounds. For this reason, a biological target in the form of the Benthic Macroinvertebrate Index of Biotic Integrity (BMIBI) has been set for Yeader Creek.

IDNR uses the BMIBI to assess the biological condition of wadeable streams throughout Iowa. The application of this target in Yeader Creek will make it possible to evaluate progress toward achieving a more desirable level of ecological health than currently exists. IDNR recognizes that attainment of the BMIBI target will depend upon other

watershed stress factors (e.g., hydro-alteration) that are not addressed in this TMDL. These other stressors must be taken into consideration when evaluating the efficacy of this TMDL in relation to the biological target.

3.4 Pollutant Allocations

Wasteload Allocation

The individual NPDES stormwater permit for the Des Moines International Airport issued August 30, 2004, includes specific limits for discharges to Yeader Creek as shown in Table 8. In addition to ethylene and propylene glycol concentration limits, the wasteload allocation in the current permit includes maximum biochemical oxygen demand and minimum creek dissolved oxygen concentration. The TMDL wasteload allocation targets for ethylene glycol and propylene glycol are identical to those found in Table 8 and in the current NPDES permit.

Table 8. Effluent limits on glycol from the stormwater NPDES permit for the DMIA.

	30-day Average concentration (mg/l)	Daily Maximum concentration (mg/l)
Ethylene Glycol	125.0 mg/l	190.0 mg/l
Propylene Glycol	100.0 mg/l	150.0 mg/l

The NPDES permit for the airport includes a limit on $CBOD_5$ concentration and a minimum concentration of dissolved oxygen as follows:

- $CBOD_5$ shall not exceed a 30-day average of 100.0 mg/l or a daily maximum of 150.0 mg/l.
- A minimum dissolved oxygen concentration of 5.0 mg/l shall be maintained in Yeader Creek at all times whenever glycol-based anti-icing or deicing compounds are used at the DMIA and glycol contaminated stormwater is discharged to the stream.

The stormwater permit also prohibits the use and discharge of glycol based Type II deicing and anti-icing compounds and require that the maximum possible amount of glycol contaminated stormwater be transported through the sanitary sewer to the Des Moines Wastewater Reclamation Facility for treatment before any discharge of glycol contaminated stormwater is made, either directly or indirectly, to Yeader Creek.

Load Allocation

There is a potential for inputs of glycol from automobile antifreeze (leaks, releases related to auto accidents) but the quantity and frequency of glycol in urban runoff is negligible. This assessment is supported by the lack of measurable levels of glycol in Yeader Creek outside of the airport's deicing season. Pollutants discharged to the creek from Des Moines storm sewers are covered under the City of Des Moines Municipal Stormwater permit. Therefore, the non-point source load allocations for ethylene glycol and propylene glycol are set at zero.

Margin of Safety

The margin of safety for this TMDL is implicit. The use of a biological target in addition to the limits on ethylene and propylene glycol in the NPDES stormwater permit provides a margin of safety. The biological target provides an assurance that the amount of glycol reaching the stream is not causing impairment of the aquatic life use. In the event that the biological target is not achieved despite there being documented evidence that the glycol discharge limits are being met, IDNR will conduct additional monitoring and stressor analysis to determine the cause(s) of biological impairment.

4. Implementation Plan

The following implementation plan is not a required component of a Total Maximum Daily Load but can provide department staff, partners, and watershed stakeholders with a strategy for improving Yeader Creek water quality. This plan has two components, one for point source discharges at low flow and one for nonpoint source discharges driven by rainfall events when stream flow is higher.

The recent improvements in stormwater quality from the DMIA appear to be having a positive effect on water quality. The new stormwater permit places restrictions on propylene glycol, which was not addressed in the original permit.

The DMIA and its partner airlines must continue to contain the deicing procedures to the designated aprons to prevent the deicing fluids from reaching the stormwater system.

Residents and businesses in the Yeader Creek watershed can improve water quality in Yeader Creek by the following:

- Do not dump oil, paint, antifreeze, or other waste into the street or storm drains. Storm drains within the watershed discharge directly into Yeader Creek.
- Limit the use of fertilizers and pesticides. Fertilizers contribute to excessive algal growth and loss of dissolved oxygen in lakes and streams. Pesticides in the water can damage the natural biological community (particularly the aquatic invertebrates) in the stream.

Several neighborhood associations are included within the boundary of the Yeader Creek watershed: the Greater South Side Neighborhood Association, the Somerset Neighborhood Association, the Magnolia Park Neighborhood Association, the South Park Neighborhood Association, and the Bloomfield/Allen Township Neighborhood Association. These associations could offer a forum to educate residents regarding the water quality in Yeader Creek and how residents could contribute to water quality improvements.

The City of Des Moines is required by its stormwater permit (8) to address nonpoint source pollution in stormwater discharged into Yeader Creek. The city can contribute to the improvement of Yeader Creek by increasing their efforts at public education regarding urban nonpoint pollution within the Yeader Creek watershed. In addition, the prompt implementation and enforcement of the Illicit Discharge Prohibition Ordinance and the Illicit Discharge Detection and Elimination Program as defined by the stormwater permit is strongly recommended.

5. Monitoring

Phase 2 of this TMDL requires a three-part monitoring strategy to evaluate compliance with TMDL targets:

1. Direct measurements of glycol concentrations in Yeader Creek relative to permitted concentrations,
2. Biological assessment of Yeader Creek and comparable urban streams, and
3. Further evaluation of reference conditions and biological targets for general use streams including Yeader Creek.

The chemical monitoring of Yeader Creek to be conducted by the DMIA is specified in the NPDES stormwater permit. Ethylene and propylene glycol concentrations will be measured twice per week at the outfall and once per week at the three downstream locations. Sampling will be conducted from October through May and at any other time that glycol is used at or discharged by the DMIA. Additional details may be found in the DMIA stormwater permit (Appendix D).

Although the BMIBI target set in this TMDL is consistent with other general use streams of similar size within the same landform region, the IDNR wishes to further evaluate this target using local and/or regional reference sites that will provide a more comprehensive basis for comparison. Any changes to the biological target based on this additional monitoring will be used to evaluate the status of Yeader Creek.

The biological assessment of Yeader Creek will be designed and performed by IDNR or its designee. This plan will consist of several bioassessments at or near the monitoring sites used by the DMIA. These assessments will be used to determine if Yeader Creek is meeting biological targets based on the BMIBI scores.

6. Public Participation

A meeting was held with DMIA and IDNR officials on June 3, 2004. A public meeting was held December 14, 2004, at the Des Moines South Side Library. Comments received were reviewed and given consideration and, where appropriate, incorporated into the TMDL.

Attendees at the December 14th meeting included representatives from the Des Moines International Airport, the Polk County Conservation Board, the Isaac Walton League, Trees Forever, the Sierra Club, and the National Audubon Society as well as residents of the Yeader Creek/Easter Lake watersheds.

7. References

1. IAC. 2002. Chapter 567-61: water quality standards. Iowa Administrative Code [effective date 8/14/02].

2. EPA. 2000. Preliminary data summary: airport deicing operations (revised). Office of Water. Document EPA-821-R-00-016. 447 pages.

3. Ritter, S. 2001. What's that stuff? Chemical & Engineering News 79:1 p. 30. (http://pubs.acs.org/cen/whatstuff/stuff/7901scit5.html)

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5. Camp Dresser & McKee. Glycol Runoff Control Permitting Compliance Strategy Report for DMIA, November 1997.

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7. IDNR. 2002. Methodology for developing Iowa's 2002 Section 303(d) list of Impaired Waters. August 2002.

8. Municipal Separate Storm Sewer System (MS4) NPDES permit for the City of Des Moines (permit # 77-27-0-07, issued July 19,2004)

8. Appendix A - Sampling Data

Table A-1. Data collected by DMIA near the airport stormwater outfall. Data are shown as monthly averages.

Date	Flow (GPM)	COD (mg/l)	CBOD5 (mg/l)	NH3-N (mg/l)	Ethylene Glycol (mg/l)	Propylene Glycol (mg/l)
10/99 (n=6)	100	18	2.5	0.38	1.0	1.0
11/99 (n=8)	75	23	2.8	0.30	2.6	1.3
12/99 (n=10)	47	125	74.6	0.37	18.3	23.6
1/00 (n=9)	38	579	386.6	0.34	51.5	37.5
2/00 (n=8)	91	255	153.0	0.36	16.0	18.8
3/00 (n=10)	38	455	290.3	0.21	33.9	130.4
4/00 (n=8)	105	175	119.6	0.19	5.4	19.4
5/00 (n=10)	1093	141	25.3	0.25	1.0	0.0
6/00 (n=8)	1608	51	19.6	0.12	0.0	0.0
7/00 (n=8)	3092	24	5.0	0.23	ns	ns
8/00 (n=9)	73	51	3.1	0.22	ns	ns
9/00 (n=9)	231	19	3.7	0.31	ns	ns
10/00 (n=8)	39	20	1.4	0.26	0.0	0.0
11/00 (n=9)	63	29	3.3	0.22	2.2	8.3
12/00 (n=9)	31	652	444.0	0.47	22.7	4.6
1/01 (n=10)	42	779	576.6	0.18	75.6	69.6
2/01 (n=8)	95	1016	443.3	0.84	57.0	84.3
3/01 (n=8)	421	236	128.7	0.25	13.3	20.6
4/01 (n=8)	315	145	70.6	0.85	4.0	1.0
5/01 (n=10)	170	40	8.4	0.17	0.0	0.0
6/01 (n=8)	254	20	2.0	0.21	0.0	0.0
7/01 (n=9)	44	25	0.9	0.27	0.0	0.0
8/01 (n=9)	686	26	2.7	0.38	ns	ns
9/01 (n=8)	31	20	1.8	0.29	ns	ns
10/01 (n=9)	202	22	1.8	0.22	0.0	0.0
11/01 (n=9)	43	19	3.0	0.21	0.0	0.0
12/01 (n=8)	20	30	1.6	0.15	0.0	0.0
1/02 (n=10)	12	19	1.9	0.27	0.0	0.7
2/02 (n=8)	236	96	53.4	0.23	13.8	20.8
3/02 (n=8)	25	44	27.1	0.26	3.2	2.3
4/02 (n=8)	42	47	22.8	0.13	0.0	0.0
5/02 (n=10)	93	17	0.6	0.13	0.0	0.0
6/02 (n=8)	165	20	0.0	0.19	0.0	0.0
7/02 (n=9)	252	22	1.4	0.00	ns	ns
8/02 (n=9)	66	16	0.3	0.02	ns	ns
9/02 (n=8)	34	21	1.5	0.23	ns	ns
10/02 (n=10)	65	34	4.8	0.16	4.4	2.1
11/02 (n=8)	58	53	25.0	0.20	2.8	1.0
12/02 (n=8)	15	21	1.5	0.15	1.2	0.0
1/03 (n=10)	40	77	36.8	0.27	7.2	3.0
2/03 (n=8)	61	86	31.8	0.26	9.0	3.4
3/03 (n=8)	110	124	58.6	0.26	7.0	5.3

Table A-1 (continued).

Date	Flow (GPM)	COD (mg/l)	CBOD5 (mg/l)	NH3-N (mg/l)	Ethylene Glycol (mg/l)	Propylene Glycol (mg/l)
4/03 (n=9)	529	115	68.7	0.10	7.0	6.9
5/03 (n=9)	150	23	8.1	0.14	1.7	0.2
6/03 (n=9)	144	26	0.9	0.13	0.0	0.0
7/03 (n=9)	43	25	2.0	0.16	0.0	0.0
8/03 (n=8)	37	24	0.0	0.13	ns	ns
9/03 (n=9)	36	30	4.1	0.48	ns	ns
10/03 (n=9)	29	23	0.6	0.16	0.0	0.0
11/03 (n=8)	679	25	2.3	0.17	0.0	0.0
12/03 (n=9)	133	63	8.2	0.56	5.0	1.2
1/04 (n=9)	24	44	11.4	0.13	3.2	6.3
2/04 (n=8)	39	141	84.0	0.14	6.1	36.8
3/04 (n=9)	288	114	68.7	0.09	8.5	19.4
4/04 (n=7)	319	27	6.5	0.15	0.0	0.0

ns – not sampled

Table A-2. Average dissolved oxygen (mg/l) in Yeader Creek collected by DMIA at the four locations. Yeader 1 is nearest the airport and Yeader 4 is nearest Easter Lake.

Date	Yeader 1	Yeader 2	Yeader 3	Yeader 4
10/99 (n=2)	9.78	3.76	4.27	5.25
11/99 (n=4)	9.93	5.96	6.72	7.14
12/99 (n=5)	10.27	10.10	10.39	8.20
1/00 (n=4)	9.21	6.19	6.60	7.73
2/00 (n=4)	9.59	5.34	6.755	7.855
3/00 (n=5)	7.73	6.47	7.05	2.83
4/00 (n=4)	7.77	8.55	8.45	7.84
5/00 (n=5)	8.49	8.52	7.82	5.35
6/00 (n=4)	7.19	7.51	6.73	5.38
7/00 (n=4)	5.69	7.20	6.74	5.20
8/00 (n=4)	9.38	5.85	5.55	4.18
9/00 (n=4)	7.54	6.23	5.43	3.84
10/00 (n=4)	8.13	3.95	3.57	3.22
11/00 (n=4)	8.70	9.36	8.90 (n=3)	4.56 (n=1)
12/00 (n=4)	9.11	7.78	7.82	8.95 (n=3)
1/01 (n=5)	8.99	6.64	7.60	8.43
2/01 (n=4)	9.77	9.19	8.59	6.19 (n=3)
3/01 (n=4)	9.66	8.74	9.93	10.69 (n=3)
4/01 (n=4)	9.24	10.32	12.17	8.26
5/01 (n=5)	8.34	8.35	7.69	6.74
6/01 (n=4)	8.40	7.38	6.95	7.36
7/01 (n=5)	8.27	5.76	4.77	6.25
8/01 (n=4)	6.92	6.05	5.69	4.39
9/01 (n=4)	7.65	7.89	6.93	4.02
10/01 (n=4)	7.93	6.63	5.37	3.71
11/01 (n=5)	7.71	5.64	4.04	1.62
12/01 (n=4)	10.09	11.36	9.95	7.67

Table A-2 (continued).

Date	Yeader 1	Yeader 2	Yeader 3	Yeader 4
1/02 (n=5)	9.30	11.26	9.87	10.87
2/02 (n=4)	12.06	14.38	12.95	7.14
3/02 (n=4)	10.19	14.15	13.65	11.28
4/02 (n=4)	9.19	12.65	11.57	6.18
5/02 (n=5)	10.08	8.92	7.96	5.60
6/02 (n=4)	8.53	6.81	5.76	6.71
7/02 (n=5)	6.94	5.78	5.23	4.53
8/02 (n=3)	8.15	6.93	6.18	6.75
9/02 (n=2)	8.54	9.08	6.02	6.07
10/02 (n=5)	7.85	6.64	6.53	3.93
11/02 (n=4)	7.73	7.67	6.50	7.75
12/02 (n=4)	9.10	11.73	8.59	6.51
1/03 (n=5)	9.71	11.99	8.87	10.55
2/03 (n=4)	5.99	5.15	6.96	2.87
3/03 (n=4)	7.07	9.39	9.38	5.48
4/03 (n=5)	9.07	10.76	10.69	7.89
5/03 (n=4)	8.38	9.91	9.02	7.74
6/03 (n=5)	6.94	6.30	6.39	5.43
7/03 (n=4)	7.07	5.46	4.92	3.93
8/03 (n=3)	7.52	6.88	4.41	6.05
9/03 (n=5)	6.28	6.85	5.89	5.83
10/03 (n=4)	7.01	5.76	5.46	5.03
11/03 (n=4)	9.03	10.43	9.99	8.56
12/03 (n=4)	9.55	12.06	12.04	7.20 (n=2)
1/04 (n=4)	11.38	15.80	13.43	10.41 (n=2)
2/04 (n=4)	9.72	11.12	11.27	7.82 (n=3)
3/04 (n=5)	9.85	11.86	12.89	10.64 (n=4)
4/04 (n=3)	10.60	10.94	12.12	10.38

Table A-3. Data collected in the fall by Level 2 IOWATER volunteers (except as noted). Types refer to invertebrate sensitivity classes; type 1 is the most sensitive and type 3 is least sensitive. True means the invertebrate was present; false means it was absent.

	9/10/2000*	10/21/2001	9/22/2002	9/28/2003
type 1				
Mayfly	FALSE	FALSE	FALSE	FALSE
Riffle Beetle	FALSE	FALSE	FALSE	TRUE
Snail no pouch	FALSE	FALSE	FALSE	FALSE
Water Penny Beetle	FALSE	FALSE	FALSE	FALSE
type 2				
Crawdad	FALSE	FALSE	FALSE	TRUE
Damselfly	TRUE	TRUE	TRUE	TRUE
Dragonfly	FALSE	FALSE	FALSE	FALSE
Water Boatman	TRUE	TRUE	FALSE	FALSE
Water Strider	FALSE	FALSE	FALSE	TRUE
type 3				
Aquatic Worm	FALSE	TRUE	TRUE	TRUE
Black Fly	FALSE	FALSE	FALSE	FALSE
Bloodworm	FALSE	FALSE	TRUE	FALSE
Leech	FALSE	TRUE	TRUE	FALSE
Midge Fly	FALSE	FALSE	FALSE	FALSE
Pouch Snail	TRUE	TRUE	FALSE	TRUE
in-stream vegetative cover				
Aquatic Plant	0-25%	0-25%	75-100%	0-25%
Algae Cover	50-75%	50-75%	0-25%	25-50%

* Sample collected by Level 1 volunteers.

9. Appendix B - Watershed Maps

Figure B-1. Watershed and sampling locations for Yeader Creek.

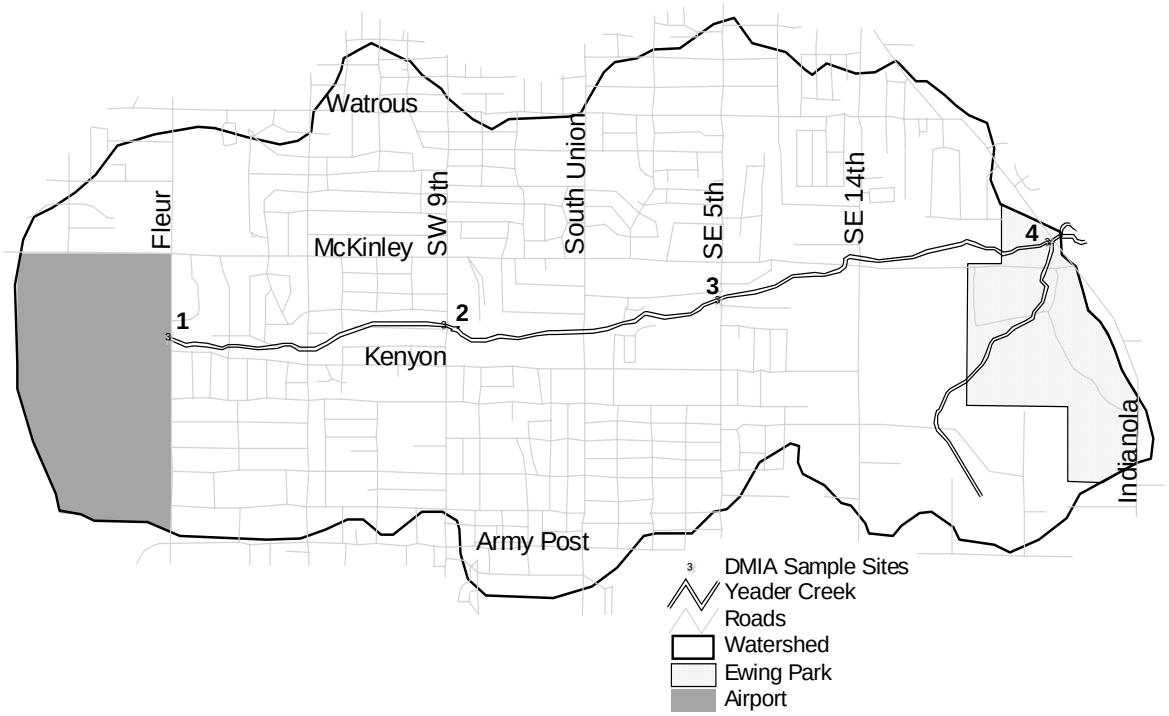

Figure B-1 shows the four monitoring locations for the airport's monitoring plan.

Site 1 is located immediately downstream of the culvert under Fleur Drive which lies at the head of Yeader Creek after the flows from both sides of the culvert have been thoroughly mixed. It provides information on DMIA stormwater discharges and is the point where the NPDES stormwater permit limits apply.

Site 2 is located at SW 9th Street and Yeader Creek. It provides information on changes in water quality about 1.2 miles downstream of the DMIA stormwater outfall.

Site 3 is located at SW 5th Street and Yeader Creek. It provides water quality information about 2.4 miles downstream of the DMIA stormwater outfall.

Site 4 is located at Indianola Road and Yeader Creek close to transition from Yeader Creek to Easter Lake. It provides water quality information about 4 miles downstream of the DMIA stormwater outfall.

10. Appendix C - Biological Assessments

Stream biological assessments incorporate benthic macroinvertebrate sampling, fish sampling, and habitat descriptions to identify and/or quantify aquatic life impairments in warmwater streams. The biological data are summarized numerically into a Benthic Macroinvertebrate Index of Biotic Integrity (BMIBI) and a Fish Index of Biotic Integrity (FIBI).

The index scores combine several quantitative measurements or "metrics" that provide a broad assessment of the biological condition of the stream. The metrics are characteristics of the biological community that can be measured reliably and that respond predictably to changes in stream quality. Characteristics such as species diversity, relative abundance of sensitive and tolerant organisms, and the proportion of individuals in certain functional feeding groups or habitat groups are used in determining the metric scores, which are then totaled to obtain the index score on a scale of 0 to 100. A general listing of the characteristics of the benthic macroinvertebrate community based on BMIBI score ranges is found in Table C-1.

Table C-1. BMIBI qualitative scoring ranges (7).

Biological Condition Rating	Characteristics of Benthic Macroinvertebrate Assemblage
76-100 (Excellent)	High numbers of taxa are present, including many sensitive species. EPT taxa are very diverse and dominate the benthic macroinvertebrate assemblage in terms of abundance. Habitat and trophic specialists, such as scraper organisms, are present in good numbers. All major functional feeding groups (ffg) are represented, and no particular ffg is excessively dominant. The assemblage is diverse and reasonably balanced with respect to the abundance of each taxon.
56-75 (Good)	Taxa richness is slightly reduced from optimum levels; however, good numbers of taxa are present, including several sensitive species. EPT taxa are fairly diverse and numerically dominate the assemblage. The most-sensitive taxa and some habitat specialists may be reduced in abundance or absent. The assemblage is reasonably balanced, with no taxon excessively dominant. One ffg, often collector-filterers or collector-gatherers, may be somewhat dominant over other ffgs.
31-55 (Fair)	Levels of total taxa richness and EPT taxa richness are noticeably reduced from optimum levels; sensitive species and habitat specialists are rare; EPT taxa still may be dominant in abundance; however, the most-sensitive EPT taxa have been replaced by more-tolerant EPT taxa. The assemblage is not balanced; just a few taxa contribute to the majority of organisms. Collector-filterers or collector-gatherers often comprise more than 50% of the assemblage; representation among other ffgs is low or absent.
0-30 (Poor)	Total taxa richness and EPT taxa richness are low. Sensitive species and habitat specialists are rare or absent. EPT taxa are no longer numerically dominant. A few tolerant organisms typically dominate the assemblage. Trophic structure is unbalanced; collector-filterers or collector-gatherers are often excessively dominant; usually some ffgs are not represented. Abundance of organisms is often low.

11. Appendix D - Des Moines International Airport Stormwater Permit